

Condensate & Feedwater

GE BWR/4 Technology Course

R-304B – 2.6

Objectives

1. Identify the purposes of the Condensate and Feedwater system.
2. Recognize the purpose, function and operation of the following Condensate and Feedwater system major components:
 - a. Condensate Storage Tank
 - b. Main Condenser
 - c. Main Condenser Hotwell
 - d. Condensate Pumps
 - e. Steam Jet Air Ejector Condenser
 - f. Steam Packing Exhauster
 - g. Condensate Demineralizers
 - h. Condensate Booster Pumps
 - i. Low Pressure Heaters
 - j. Feedwater Pumps
 - k. High Pressure Heaters

Objectives

3. Describe the following flowpaths of the Condensate and Feedwater system:
 - a. Condensate & Demineralized Makup Water System
 - b. Hotwell Level Control
 - c. Condensate System
 - d. Feedwater System
 - e. Exhaust Hood Spray
 - f. Short Cycle Cleanup
 - g. Long Cycle Cleanup

Objectives

4. Identify the purpose or function of the following Condensate and Feedwater System setpoints:
 - a. Condensate Demineralizer High Temperature
 - b. Condensate Demineralizer Resin Depletion
 - c. Condensate Booster Pump Low Suction Pressure
 - d. Feedwater Pump Low Suction Pressure

Objectives

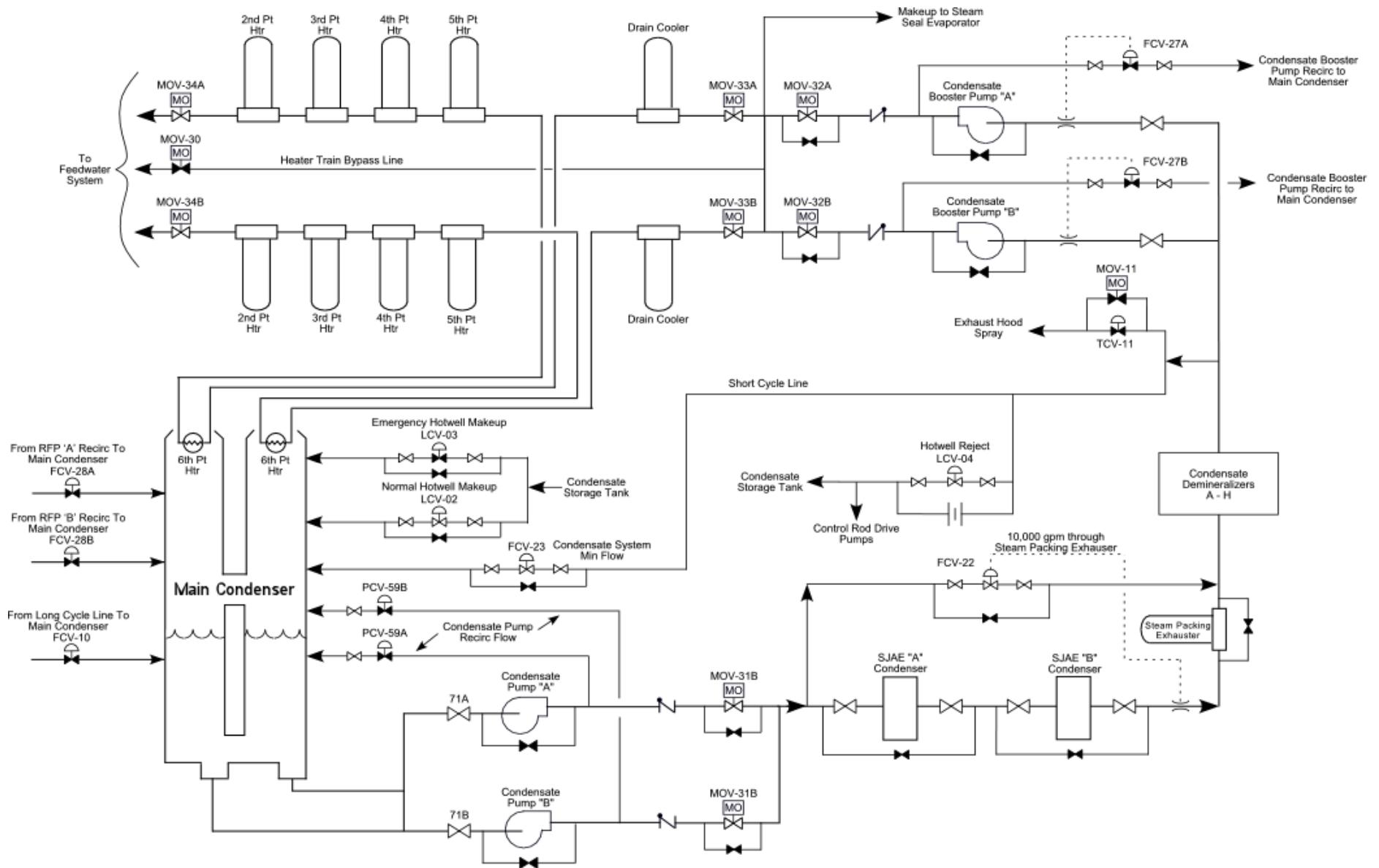
5. Describe how the Condensate and Feedwater system interrelates with the following systems/components:
 - a. Circulating Water System
 - b. Control Rod Drive System
 - c. Feedwater Control System
 - d. Reactor Water Cleanup System
 - e. High Pressure Coolant Injection System
 - f. Reactor Core Isolation Cooling System
 - g. Main Steam System
 - h. Offgas System

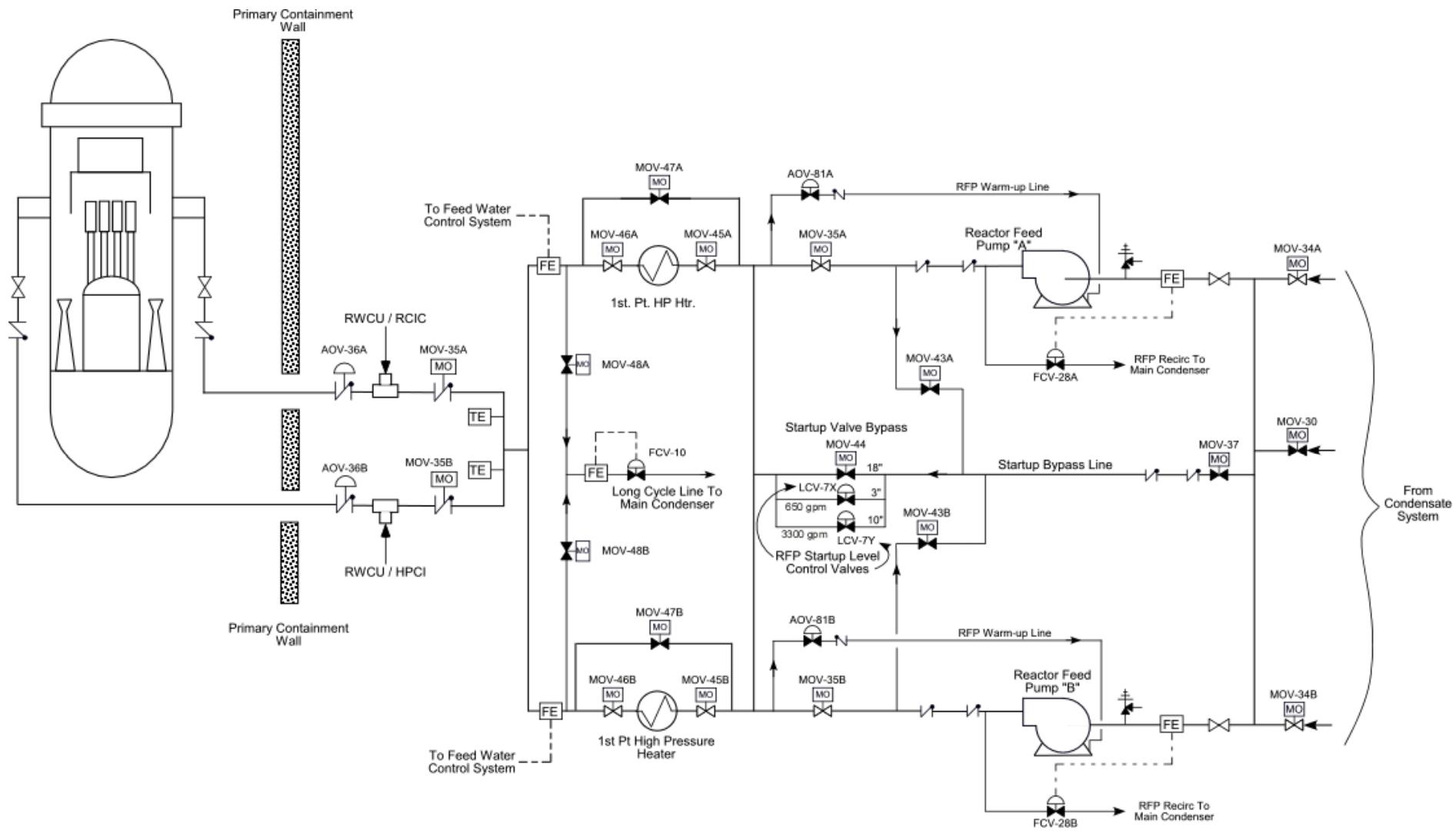
Condensate & Feedwater System Purposes

- Condense Steam
- Collect Steam Drains
- Remove Noncondensable Gases
- Purify
- Preheat
- Pump Water to Reactor Vessel
- Provide path to Reactor Vessel for :
 - High Pressure Coolant Injection
 - Reactor Core Isolation Cooling
 - Reactor Water Cleanup

Condensate & Feedwater System Major Components

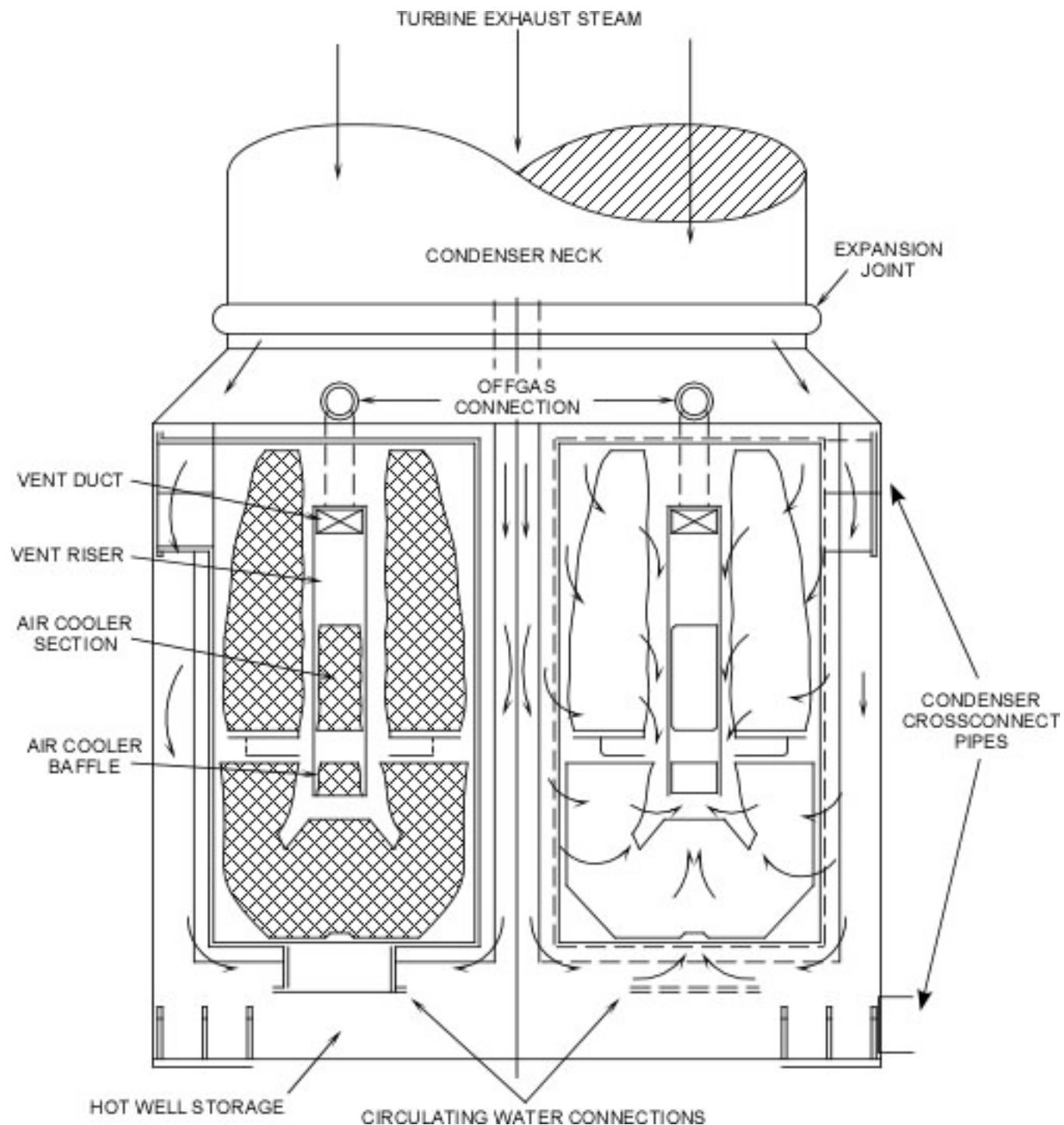
- Condensate Storage Tank
- Main Condenser
- Main Condenser Hotwell
- Condensate Pumps
- Steam Jet Air Ejector Condenser
- Steam Packing Exhauster
- Condensate Demineralizers
- Condensate Booster Pumps
- Low Pressure Heaters
- Feedwater Pumps
- High Pressure Heaters
- Extraction Steam





Main Condenser

- Two Condensers
- Deaerate
- Radial Flow Surface Condensers
- Divided Water Boxes
- Collects LP Turbine Exhaust
- Cooled by Circulating Water System
- Heat Sink for:
 - RFP Exhaust
 - Turbine Bypass
 - Low Pressure Htr Drains
 - Air Ejector Condenser Drains
 - Steam Packing Exhauster
 - Feedwater Htr shell vents
 - Pump flows
 - Minimum Recirculation Flow



Main Condenser Hotwell

- Integral part of the Main Condenser
- Collects condensate
- Connected by Equalizing lines
- Designed to retain water for minimum of two minutes
 - Nitrogen – 16 decay half-life - 7.11 seconds
 - At minimum operating hotwell levels

Condensate Pumps

- Two pumps
- Provide adequate net positive suction head for Condensate Booster Pumps
- Capacity 12,153 gpm at ~ 200 psig

Steam Jet Air Ejector Condenser

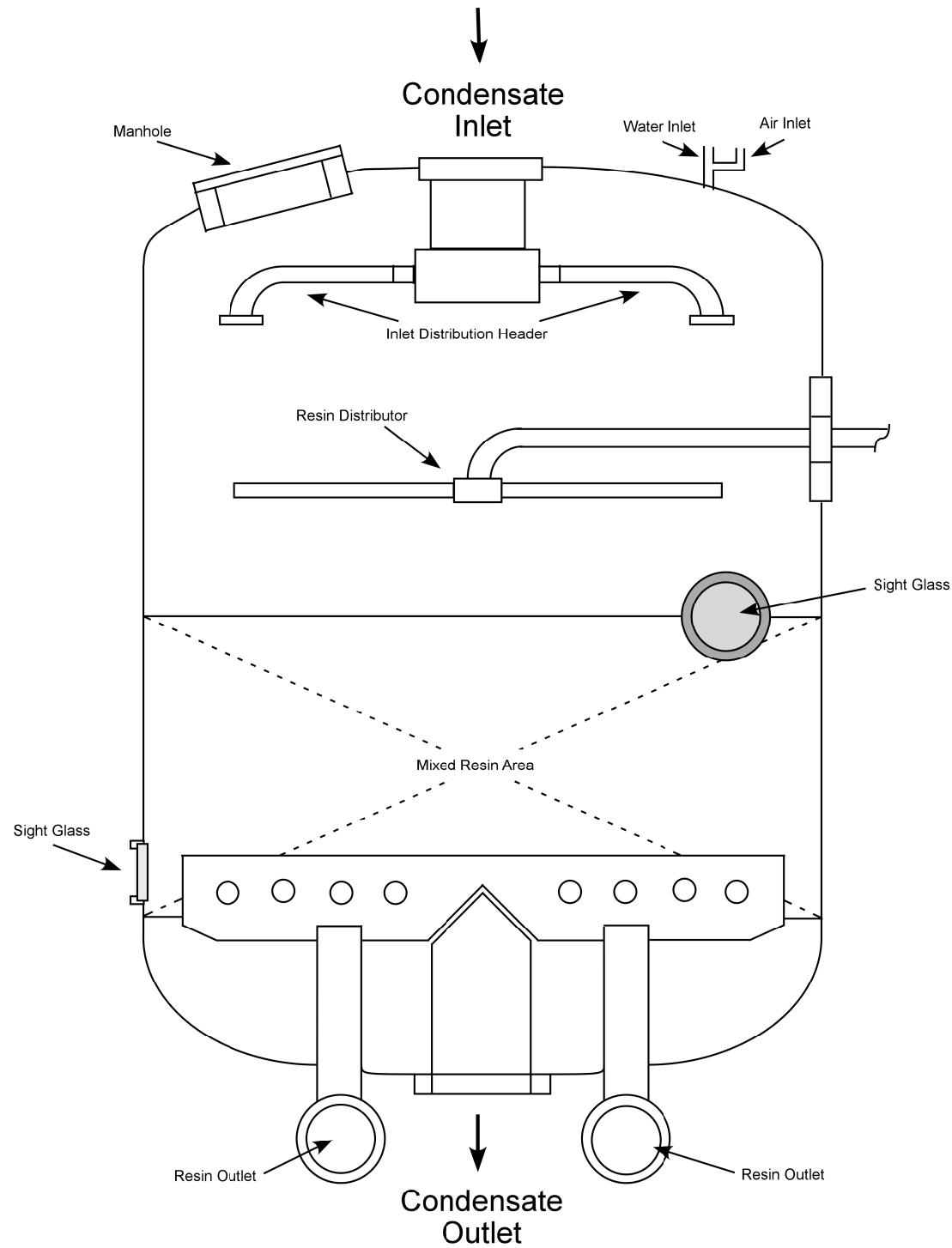
- Condense steam from first stage steam jet air ejectors
- Condensate flows through both SJAЕ condensers

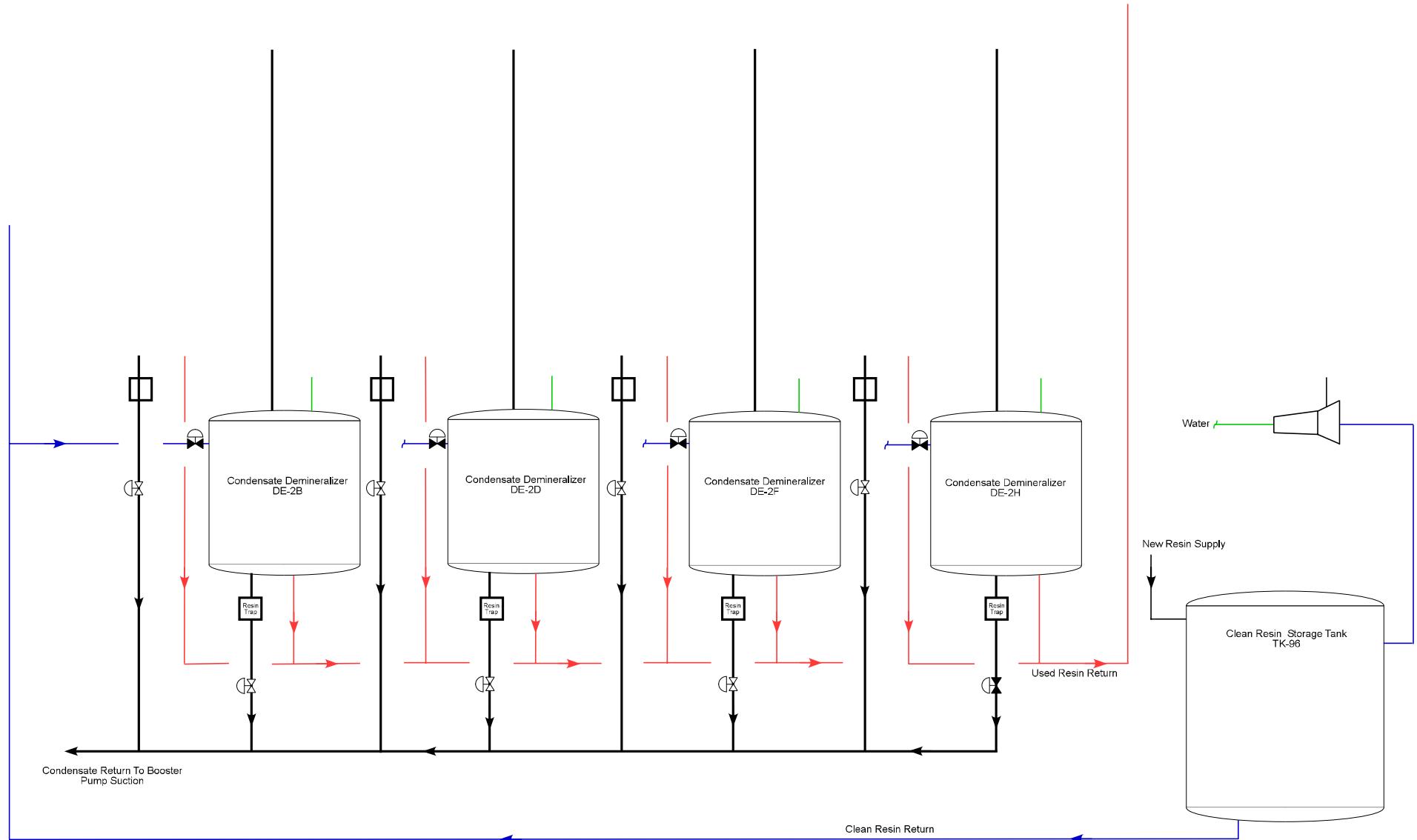
Steam Packing Exhauster

- Condenses leak-off steam from turbine seals
 - Main Turbine
 - Reactor Feed Pumps

Condensate Demineralizers

- Remove dissolved and suspended impurities
- Purify steam cycle water
- Maintain reactor water quality limits
- 8 units total, 7 required for full power
- Ultrasonic resin cleaning
- High conductivity or high D/P requires resin replacement



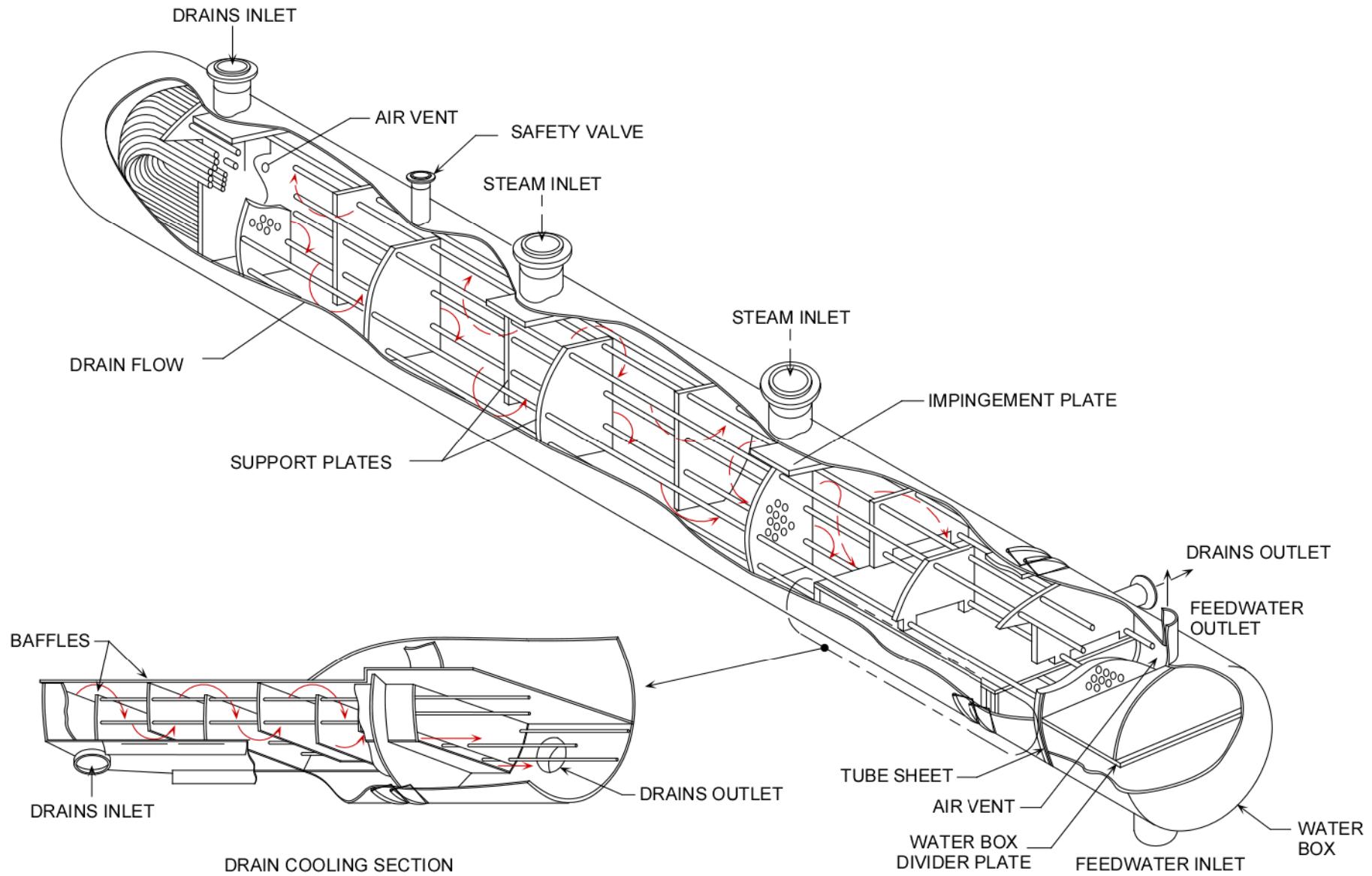


Condensate Booster Pumps

- Two pumps
- Provide adequate net positive suction head for Reactor Feed Pumps
- Capacity 12,153 gpm at ~ 600 psig

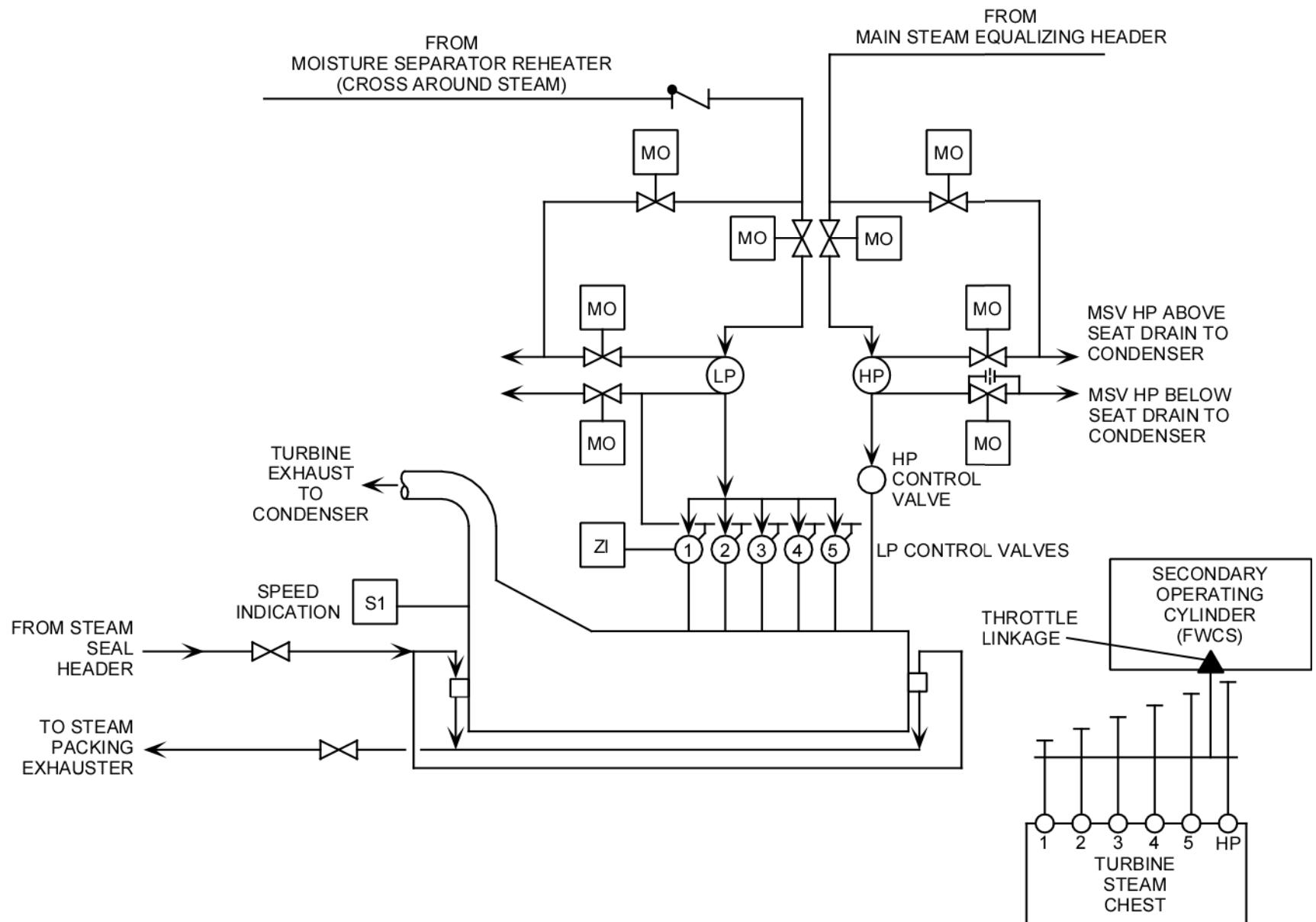
Low Pressure Heaters

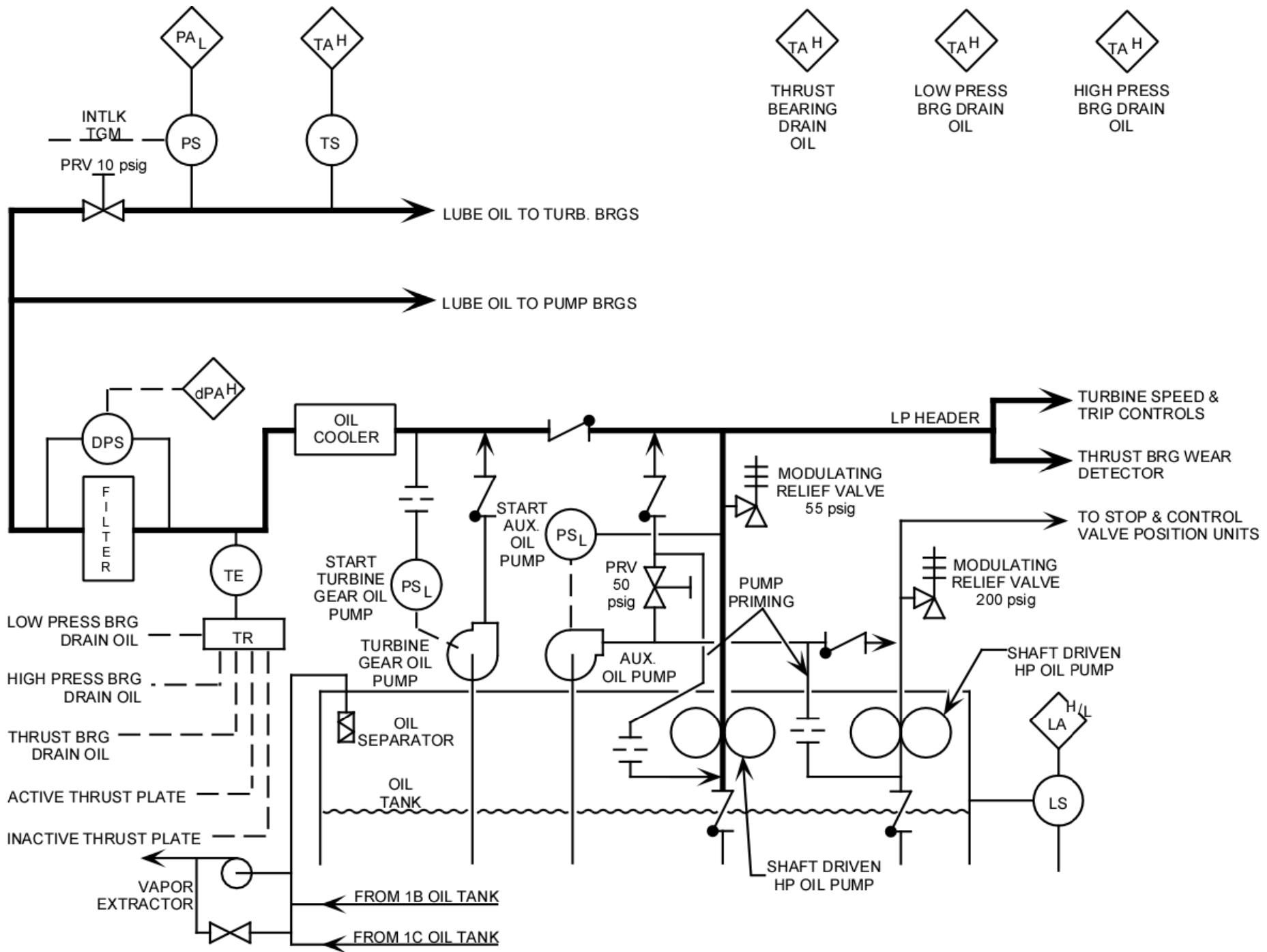
- Increase Plant Efficiency
- Two parallel heater string paths
- Extraction steam used to heat feedwater
- Feedwater flows through steam region on first pass
- Second pass through the water box portion of the heater
- Drains cascade to a lower pressure heater



Feedwater Pumps

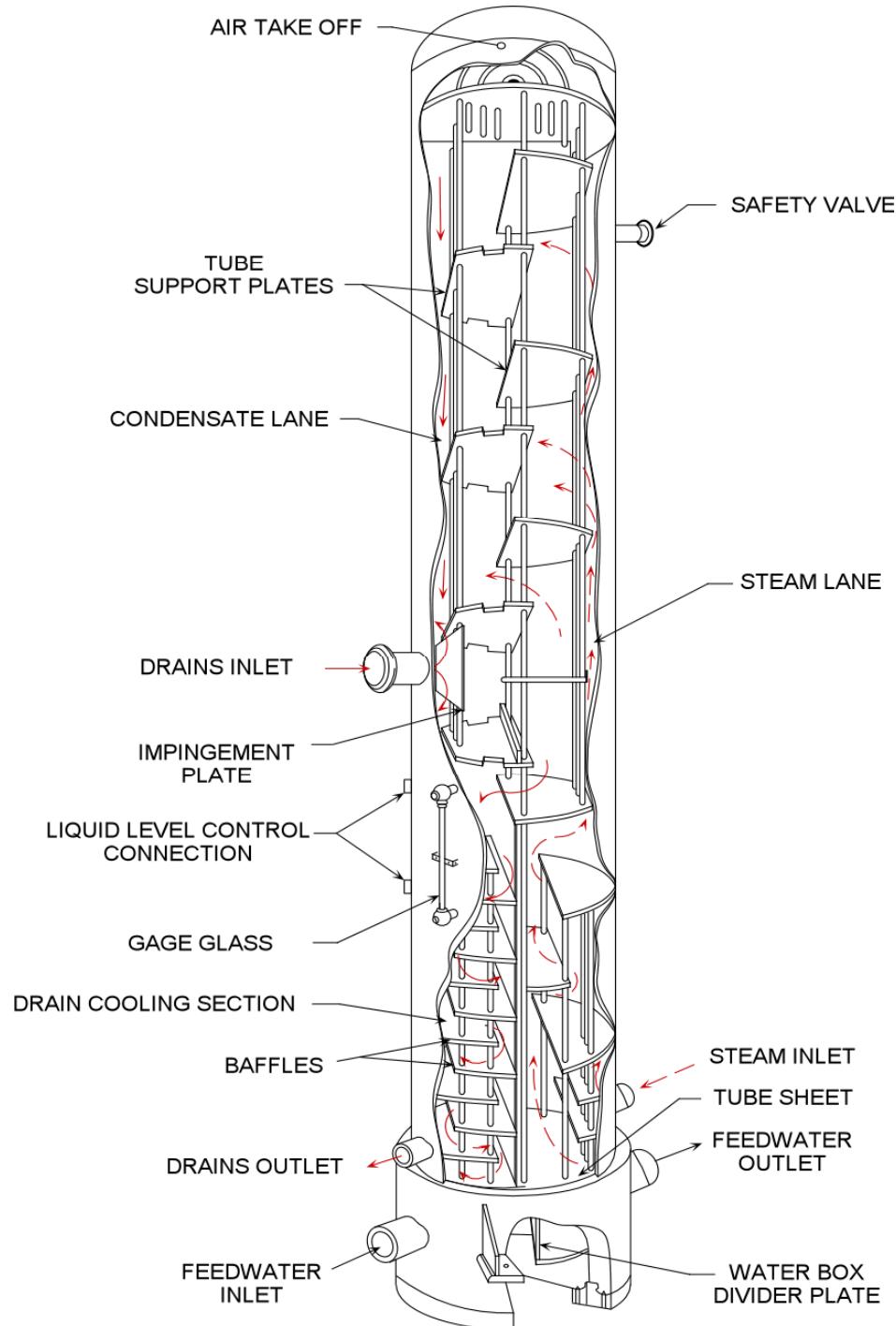
- Two steam driven pumps
- Provide driving force to inject water into reactor vessel
- 14,000 gpm at ~ 1130 psig
- 67% of system capacity each
- Two sets of control valves
 - Low pressure steam from Moisture Separator/Reheaters, normal supply
 - High pressure steam from Main Steam Equalizing Header

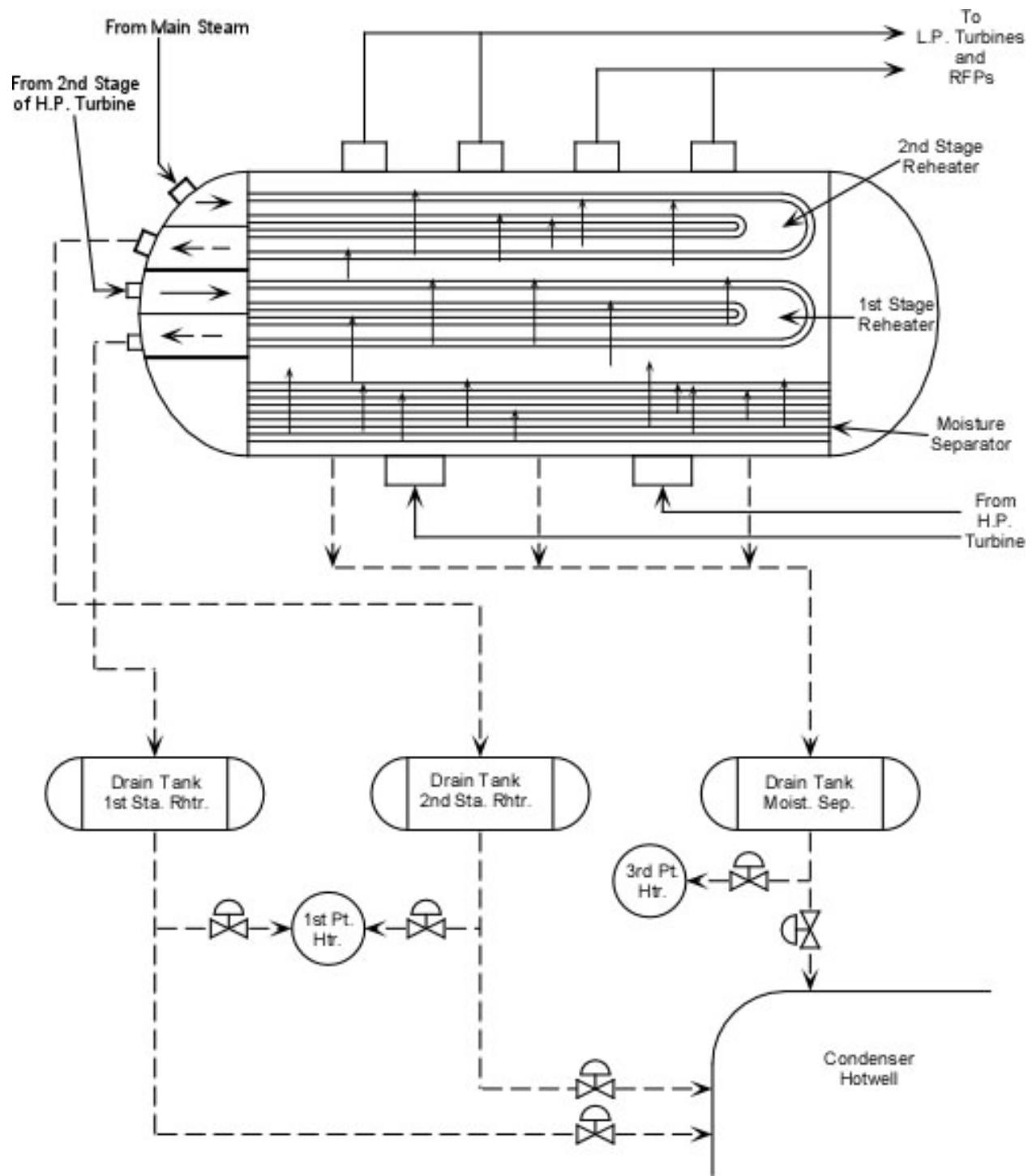




High Pressure Heaters

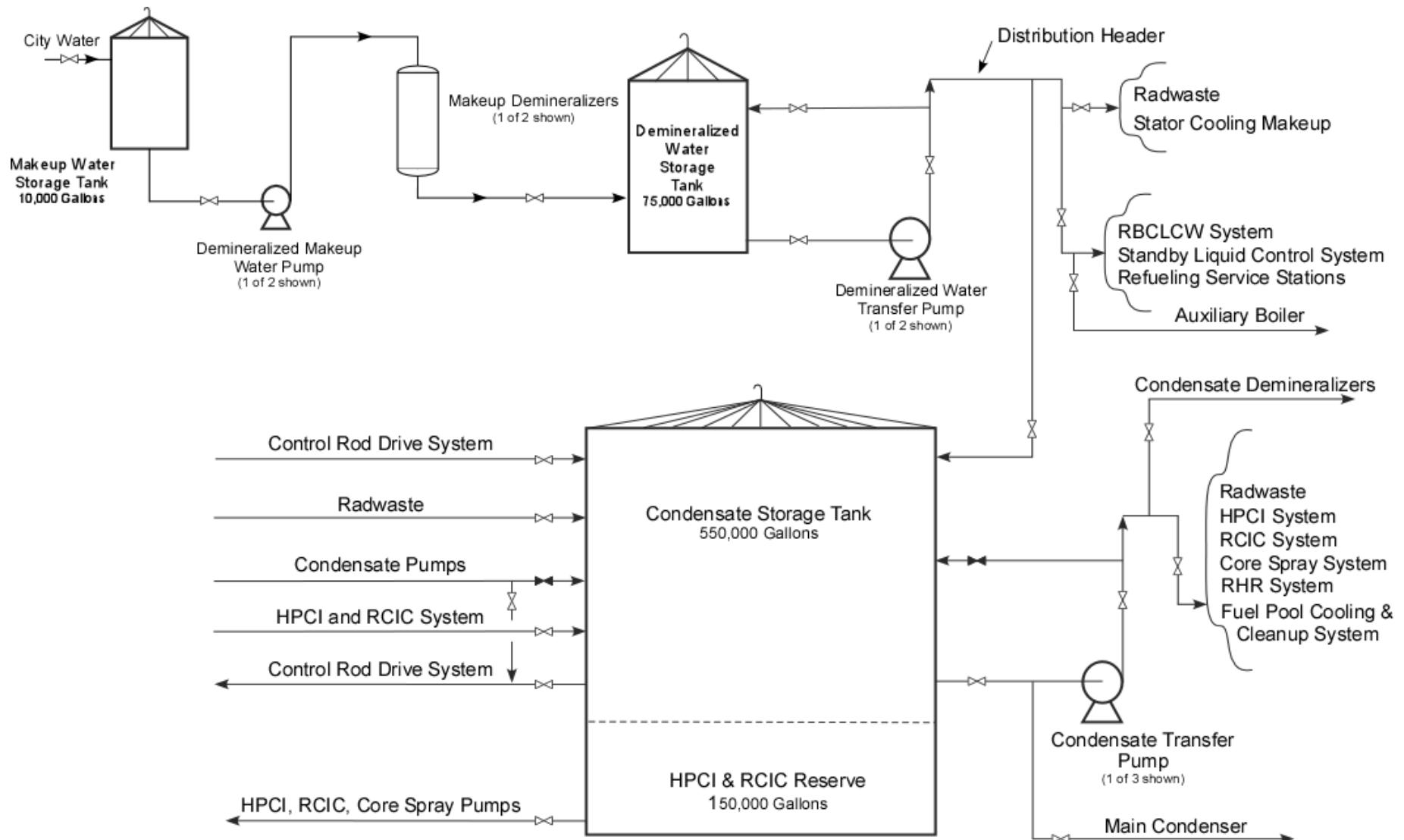
- Last stage of feedwater heating
- Uses high pressure extraction steam from HP Turbine
- ~ 420°F Feedwater Injection temperature to reactor vessel



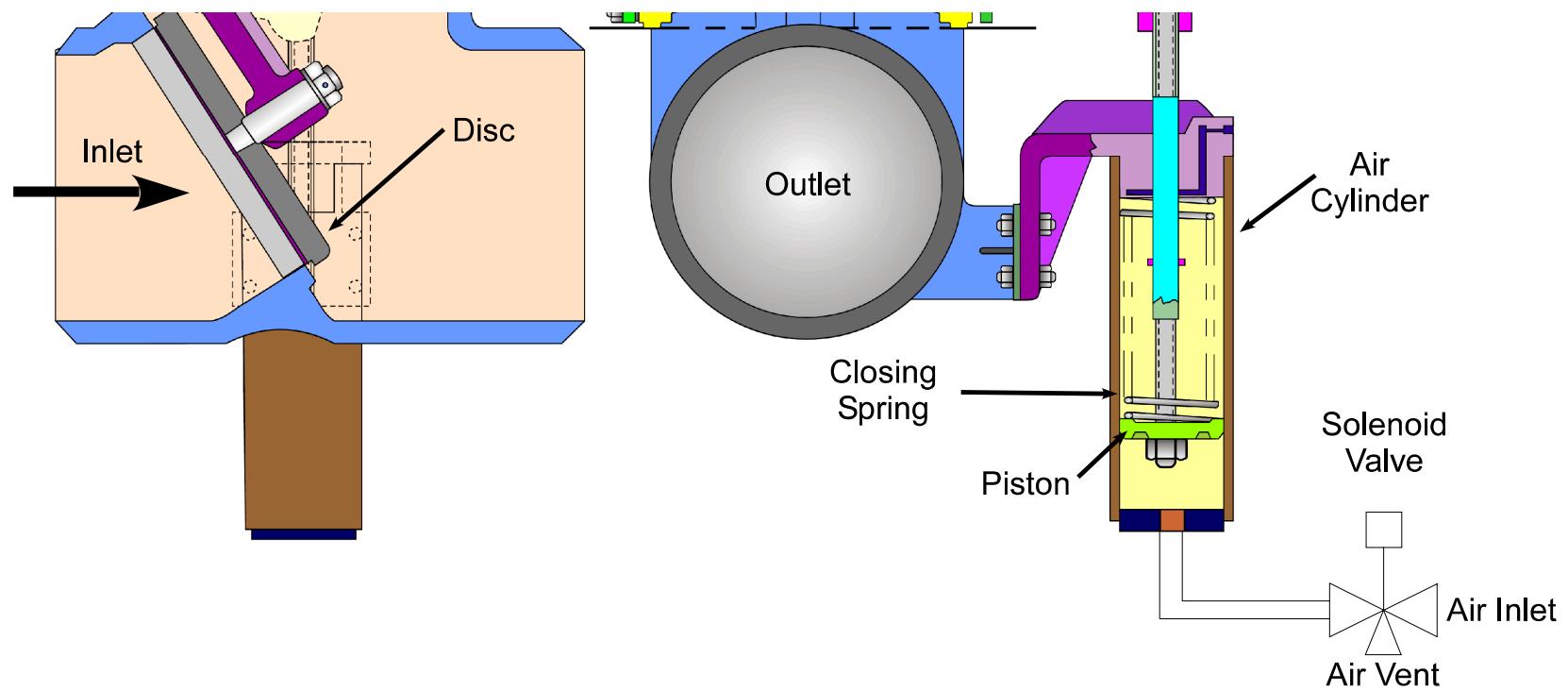


Condensate Storage Tank

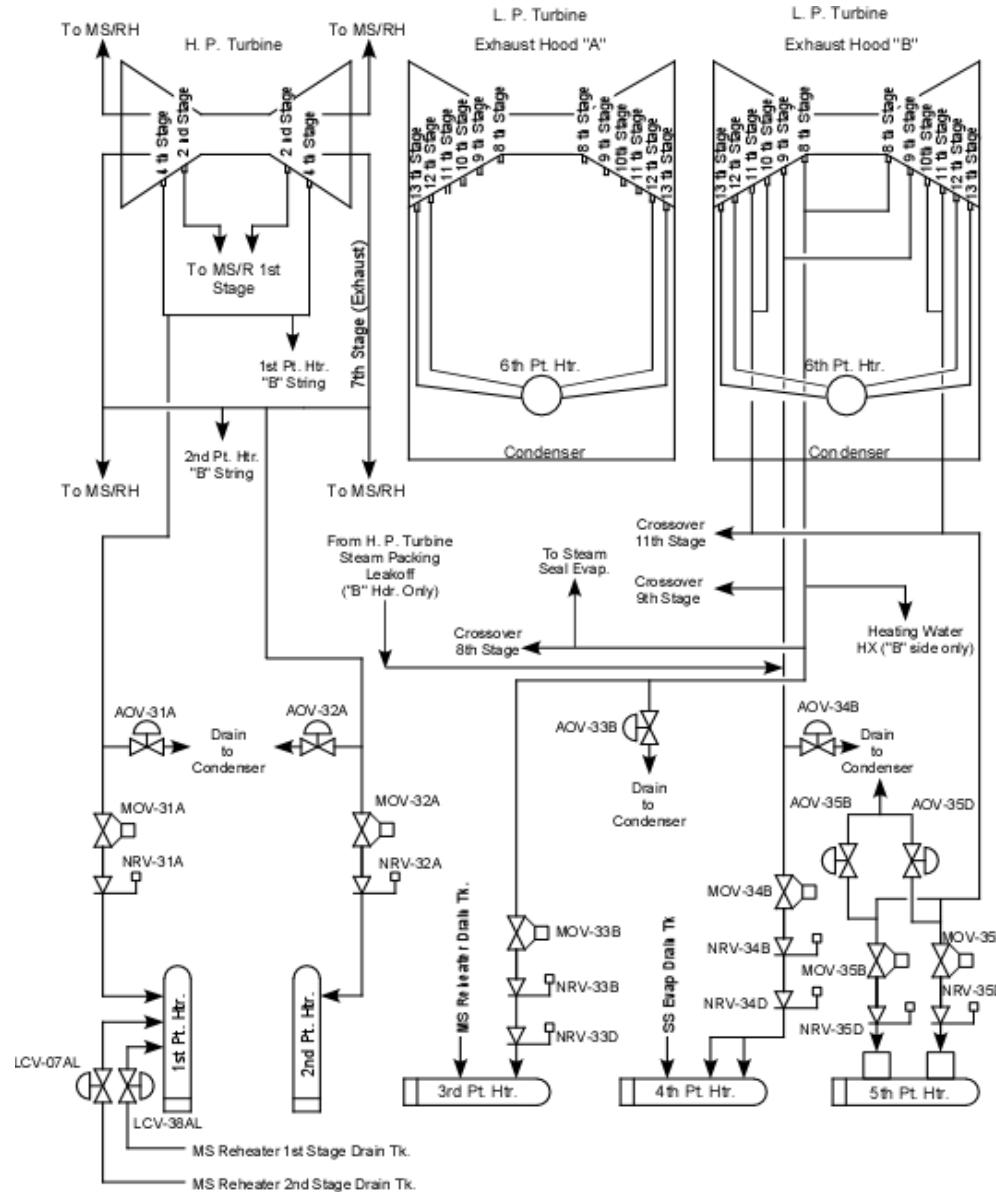
- Capacity - ~ 500,000 gallons
- 150,000 gallons dedicated for
 - High Pressure Coolant Injection
 - Reactor Core Isolation Cooling
- Typically located outdoors
- Provides makeup supply to hotwell
- Provides rejection source for hotwell



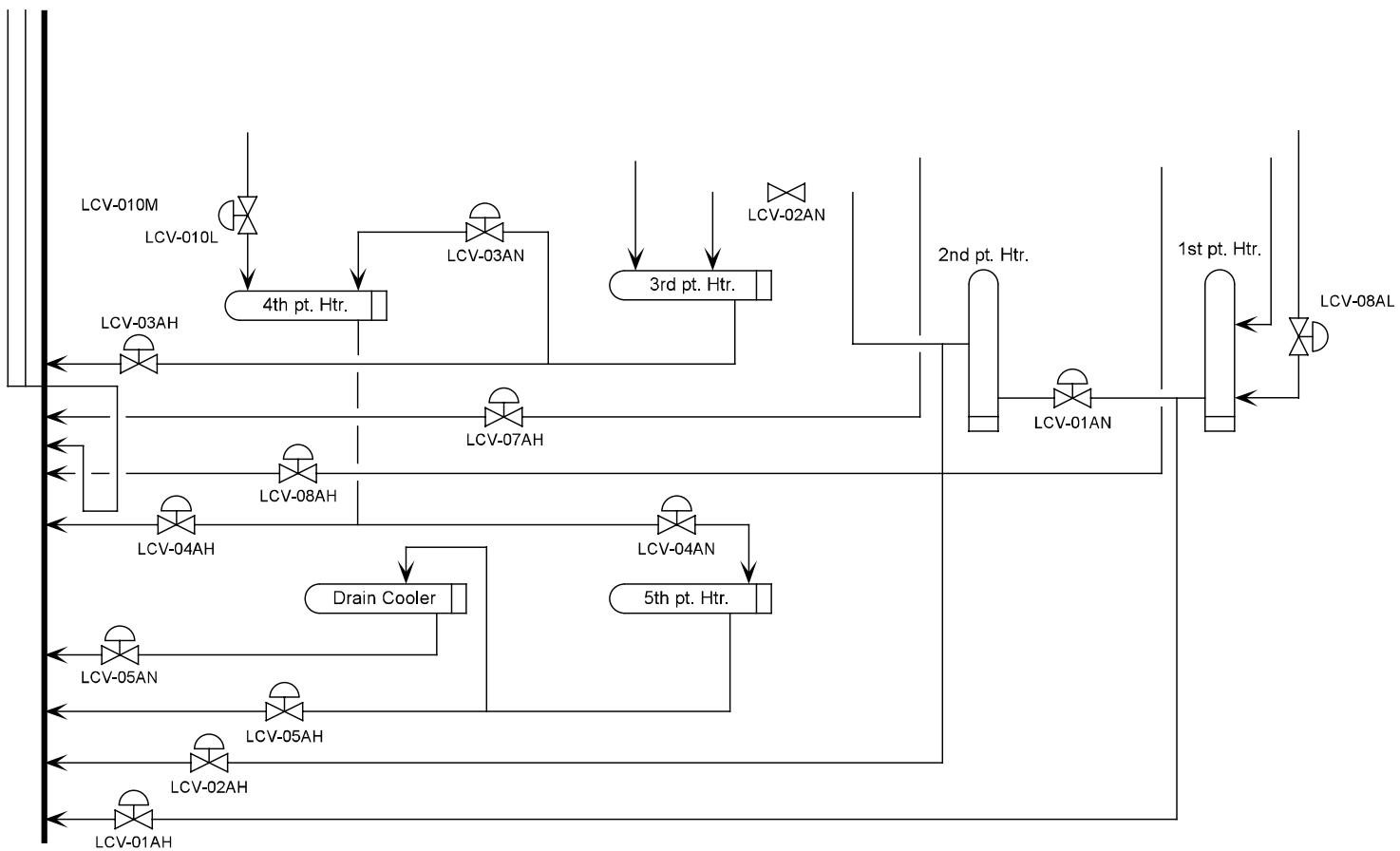
Non-Return Valve



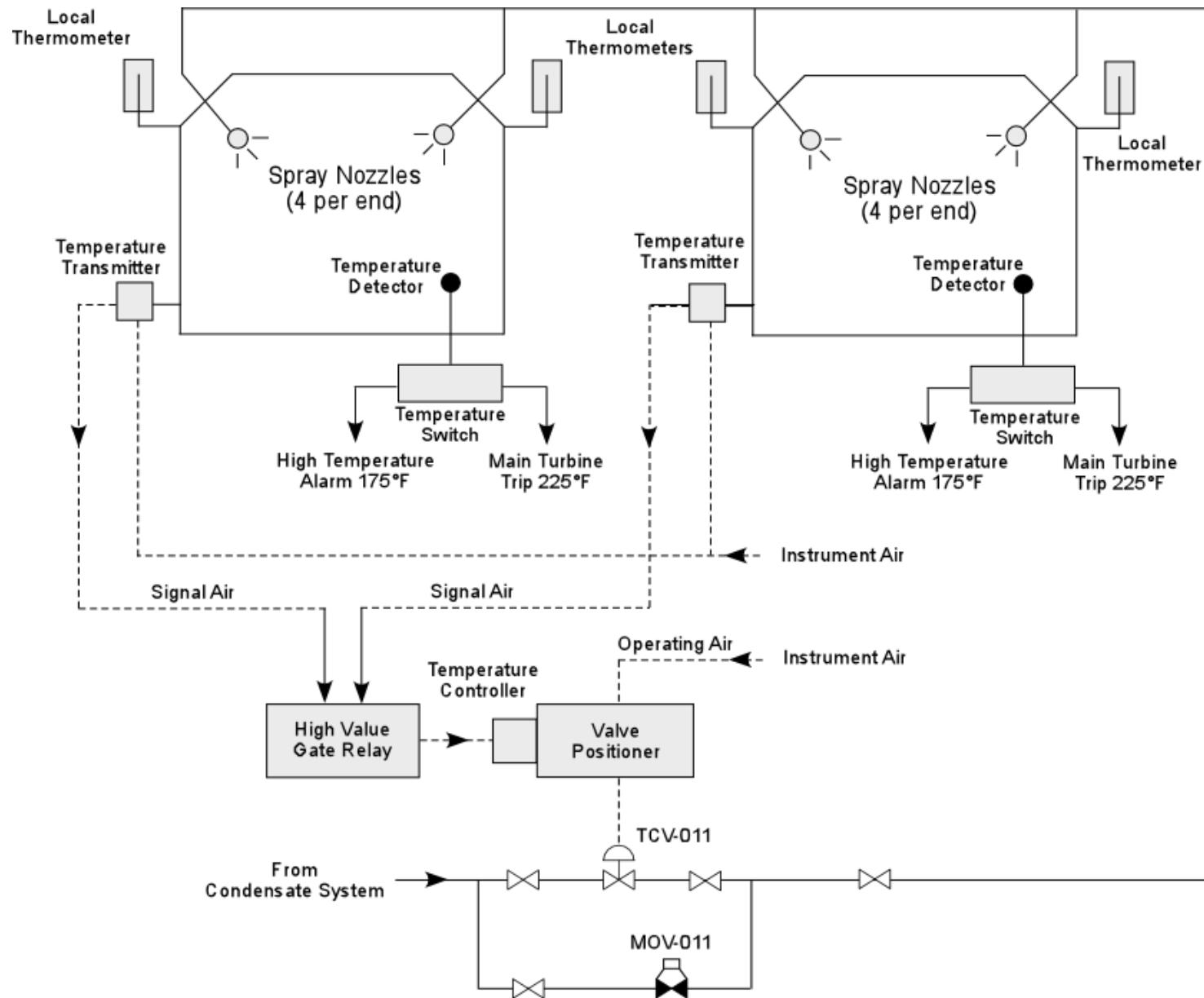
Extraction Steam



Heater Drains

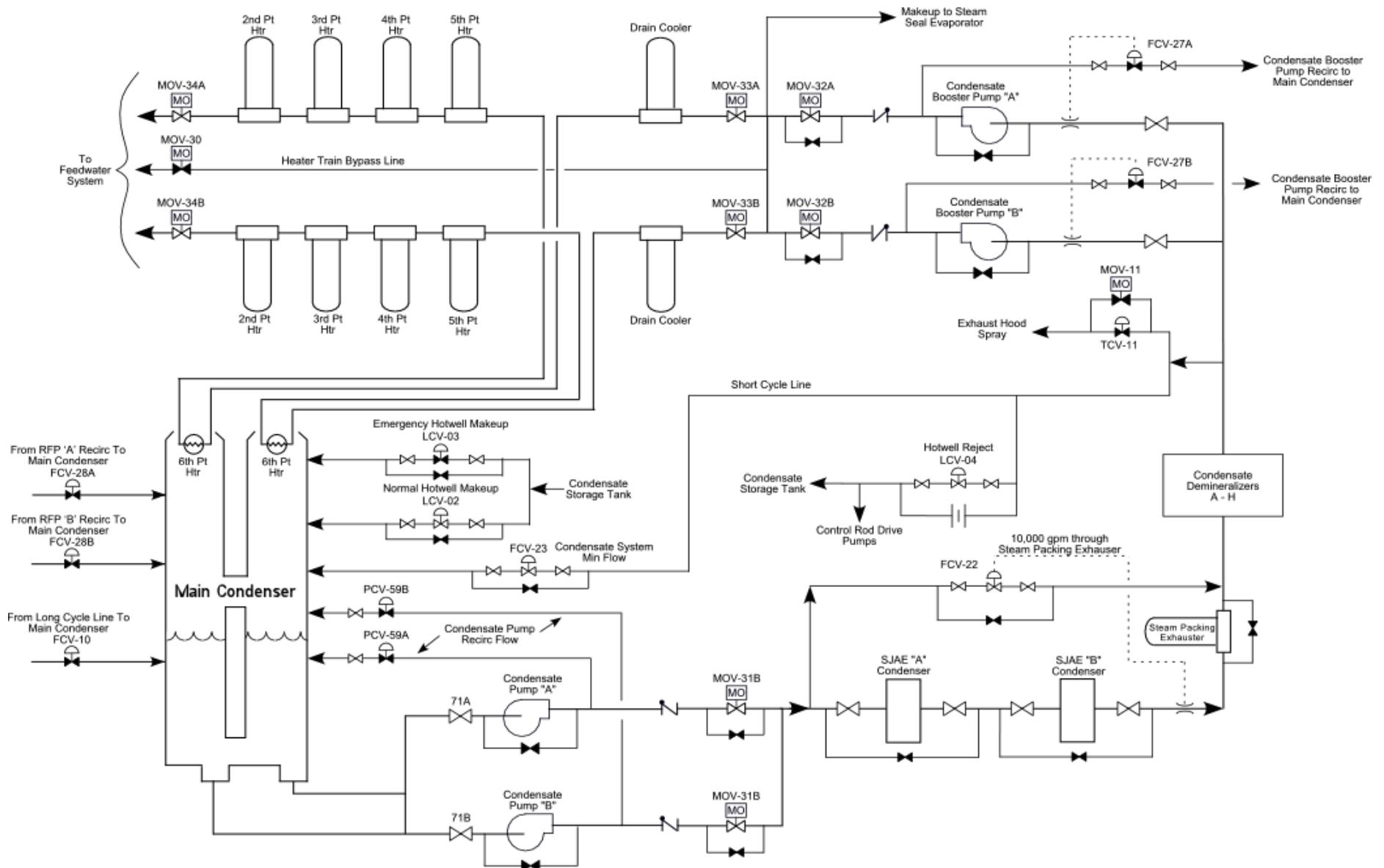


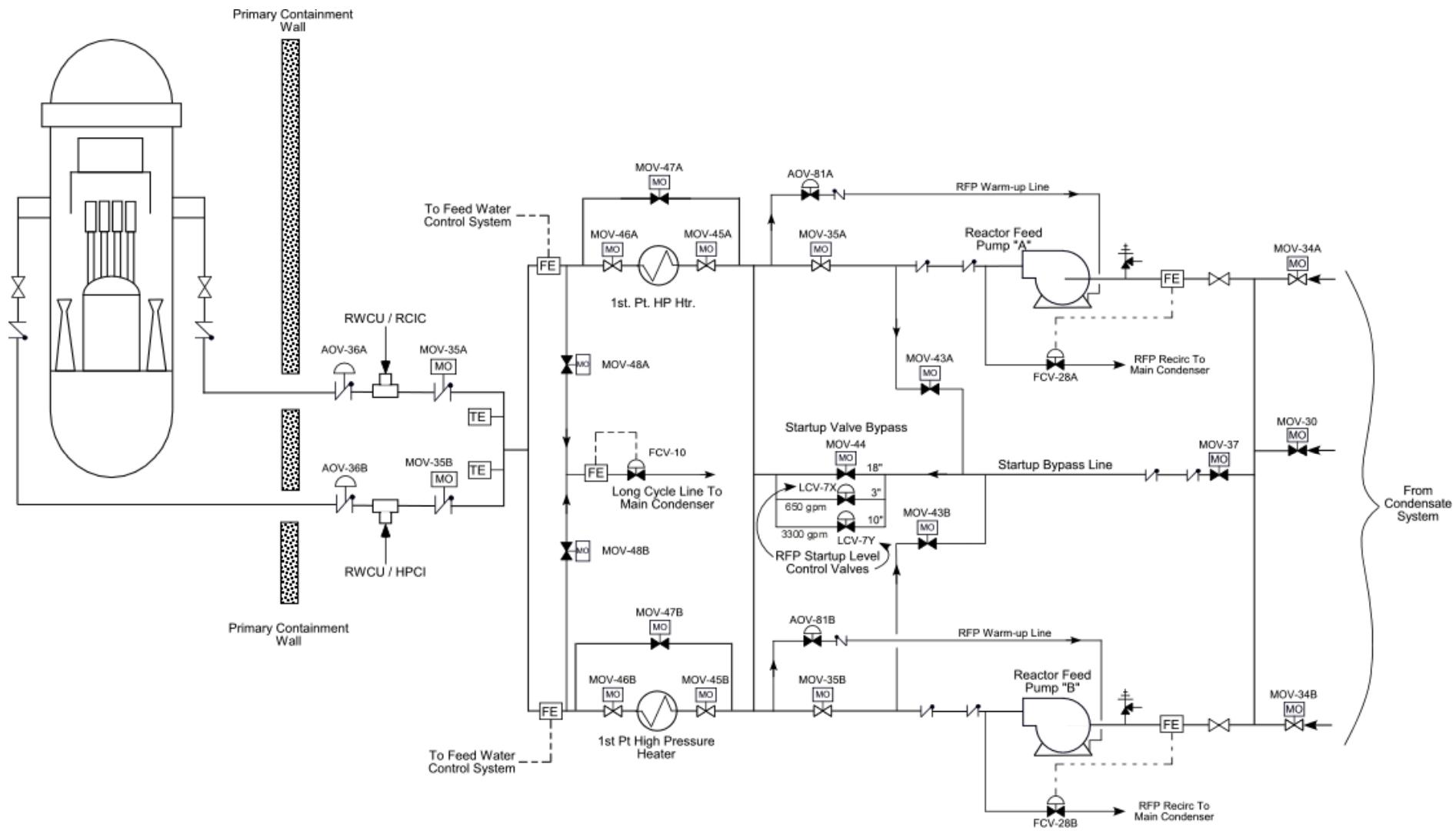
Exhaust Hood Spray

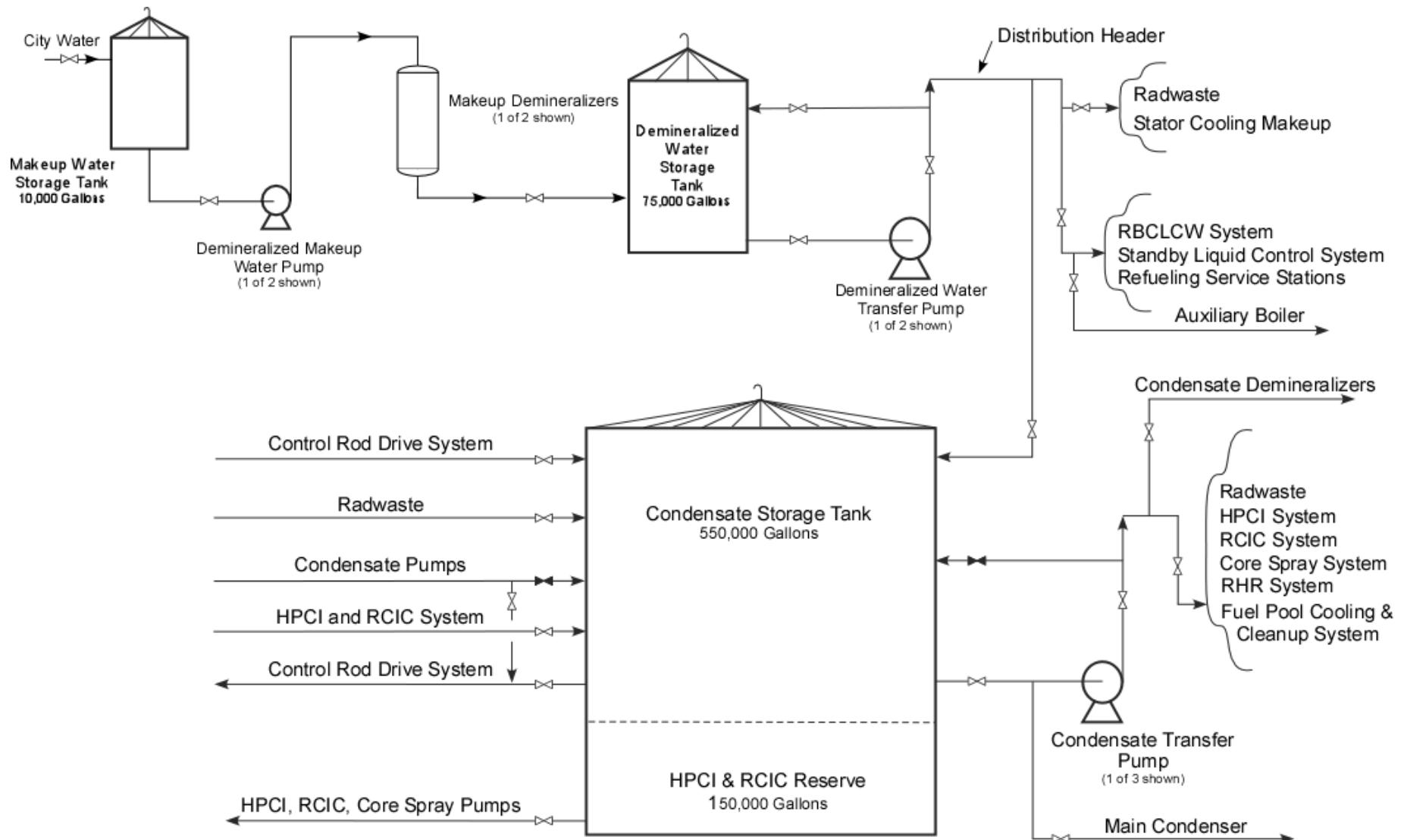


Condensate & Feedwater System Flowpaths

- Hotwell Level Control
- Condensate System
- Feedwater System
- Exhaust Hood Spray
- Short Cycle Cleanup
- Long Cycle Cleanup
- Demineralizer Water System
- Condensate Storage & Transfer System







Condensate & Feedwater System Setpoints

- Condensate Demineralizer High Temperature
- Condensate Demineralizer Resin Depletion
- Condensate Booster Pump Low Suction Pressure
- Feedwater Pump Low Suction Pressure

Demineralizer High Temperature

- > 130°F
- Manually bypass
- Resin melts ~ 150°F to 160°F

Demineralizer Resin Depletion

- High Differential Pressure – 40 psig
 - Typically requires cleaning
- 0.1 µmho/cm
 - Typically requires resin replacement

Suction Pressure Trips

- Condensate Booster Pump Low Suction
 - 35 psig
 - ‘A’ Pump time delay trip 20 seconds
 - ‘B’ Pump time delay trip 45 seconds
- Feedwater Pump Low Suction
 - 250 psig
 - ‘A’ Pump time delay trip 8 seconds
 - ‘B’ Pump time delay trip 25 seconds

System Interrelations

- Circulating Water System
- Control Rod Drive System
- Feedwater Level Control System
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Questions

- or -

Comments